Scalar Resiliency in the Age of Disruption

Brandon Aultman

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SCALAR RESILIENCY IN THE AGE OF DISRUPTION:  
DESIGNING FOR RESILIENCY AGAINST DISASTER AND CLIMATE CHANGE  

Area of Study: Biloxi, Mississippi  

Thesis Proposal is Presented to the  
Faculty of the Department of Architecture  
School of Architecture and Construction Management  
By  
BRANDON PAUL AULTMAN  

In partial fulfillment of the requirements for the Degree:  

Bachelor of Architecture  

Kennesaw State University
scalar Resiliency in the Age of Disruption

Natural storm surges and global sea level rise cause devastating effects, whether it's leaving over a million residents homeless or dooming an entire coastline ecosystem with little to no hopes of recovery. Current responsive methods consist of unequal prioritization within coastal resiliency design because of site scalar characteristics. A design that incorporates an equity of attention towards all elements of resiliency will lead to a responsive solution that can transcend any scale of site. I will begin to analyze the elements of effective resiliency; adaptation, affordability, community, sustainability and customization, in order to provide a balanced solution to ecological disruption and housing displacement. To reinforce this multi-use strategy, this solution would begin to promote interconnection between programmatic elements; ones that consist of both ecological strategies and housing amenities, in order to unify both nature and people, through the five criteria of effective resiliency. This solution would be applied towards a coastal region along the Gulf of Mexico, one that is prone to natural disruption caused by disastrous flooding, as well as having a history of disaster from a hurricane. This site is Biloxi, Mississippi. This interconnection solution goes beyond the typical resilient design properties of being scale specific and accepts disasters like Katrina and sea level rise; through effective resiliency strategies to create mutual opportunities to allow both nature and people to thrive.
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Dedication to Faculty, Friends and Family

To everyone that helped me and supported me during this final year of architecture school... I would like to personally thank:

* My thesis advisors Timothy Frank and Ed Akins II for pushing me to visit Biloxi, MS, giving me their honest suggestions and lastly, having faith in me to complete my thesis with craft and quality.

* David Perkes for taking time out of his busy schedule to give me insightful information regarding Biloxi, MS during my site visit in December.

* My close “arch” friends; Damari, Laura, Jonné, and Giovonni for all the support and friendship, as we all suffer together during our five years in architecture school.

* My mom, dad, brothers and childhood friend, Jake, for the much needed refuge and emotional support that was provided during the long weekends and breaks.

* And lastly, to my girlfriend, Katrina, for all the patience, encouragement and love during these last five years of school.
1.0 Thesis Relevance: Why is it a problem?
Design Hypothesis

Natural storm surges and global sea level rise cause devastating effects, whether it’s leaving over a million of residents homeless or dooming an entire coastline ecosystem with little to no hopes of recovery. Current responsive methods consist the issue of unequal prioritization within coastal resiliency design because of site scalar characteristics. A design that incorporates an equity of attention towards all elements of resiliency will lead to a responsive solution that can transcend any scale of site. I will begin to analyze the elements of effective resiliency; adaptation, affordability, community, sustainability and customization, in order to provide a balanced solution to ecological disruption and housing displacement. To reinforce this multi-use strategy, this solution would begin to promote interconnection between programmatic elements; ones that consist of both ecological strategies and housing amenities, in order to unify both nature and people, through the five criteria of effective resiliency. This solution would be applied towards a coastal region along the Gulf of Mexico, one that is prone to natural disruption caused by disastrous flooding, as well as having a history of disaster from a hurricane. This site is Biloxi, Mississippi. This interconnection solution goes beyond the typical resilient design properties of being scale specific and accepts disasters like Katrina and sea level rise; through effective resiliency strategies to create mutual opportunities to allow both nature and people to thrive.
Thesis Relevance of Design Hypothesis

A Glance at Climate Change

Currently, over 53% of the United States population lives near or on coastal regions. With largely populated areas along the coast such as, New Orleans, LA, New York, NY, Savannah, GA, Ft. Lauderdale, FL and other regions, these cities are most vulnerable to even one meter or sea level rise. This is due to the overall lack of resistance or lack of priority that some regions of these cities provide for their coastal inhabitants. As seen with Figure 1 and Figure 2 to the right, these show the results that even a slight global change in temperature would cause on a coastal city. Global climate change is not just comprised of sea levels rising, it is also a result of an increase in CO2 emissions that increase the GHG (Greenhouse Gases) within our atmosphere, ultimately increasing the global temperature. Which then, causes the ice caps to begin reducing solidity and melt, adding millions of gallons of water into the existing oceans. And unfortunately, at the current rate of GHG’s by PPM (parts per million) being contributed towards the atmosphere, we are likely to see a rise in 2°C or 3°C this century. Unfortunately, the last era when the Earth was that warm was 125,000 years ago during the interglacial period, and sea levels rose approximately 4 to 6 meters higher than today.
Results of Disaster

All over the world, natural disasters cause traumatic and destructive results, whether it’s earthquakes, wildfires, avalanches, etc. But, compared to these disasters, the type of disaster that is the most destructive would be the hurricanes. These massive water cyclones not only cause major destruction due to high wind speeds and flying debris, but the surge that follows, flooding thousands of square miles with unsanitary, contaminated and murky water. If the aftermath of a hurricane on a local community doesn’t physically destroy the structures, then the post flooding will.

Within the past 30 years, we as humans prepare for these hurricane disasters in the same way; retrieve the most amount of supplies that we can physically carry, contact our friends and family and hope that we can leave in time before we run into traffic of other people undergoing the same process. But the bigger picture is not what we are bringing with us, it’s what we are leaving behind. Whether its through physical destruction or forced evacuation, our homes are abandoned and left in the path of the incoming destruction, and all we can do as evacuees is sit back and observe.

One disaster in particular, Hurricane Katrina, was one of the most destructive natural disasters that the US has ever experienced. Other than the $125 billion dollars in damages, over 500,000 residents were left completely homeless, and within the entire city of New Orleans, more than 80% was under or inflicted by water. Figure 3 and Figure 4 to the right show imagery of the characteristics of a Category 3 Hurricane and the disastrous effect it brings to a city. Not only from a human standpoint, but also, an ecological standpoint.

We seem to understand tragedy only when it affects people, however, we are not the only ones that are traumatized and left hopeless in the wake of this destruction. The ecological infrastructure on the coastlines are heavily affected by these surges, and cause disruption such as reducing freshwater wetlands, increasing areas of erosion and destroying locally grown vegetation that is little to impossible to grow back. This causes a major unbalance between us and nature, and regardless of past theories, we do rely on nature for our own health. And if both us and nature are affected by the same event, it can and will cause multiple issues within the near future.
1.1 Hypothesis Parameters: From research, what characteristics provide effective resiliency?

As we can see, natural storm surges and climate change are inevitable, regardless of other’s theories, and we as a nation that is apart of this changing world need to be concious of that. And unfortunately, aside from other efforts towards this destructable outcome, a reoccurring problem that we have is a repeated action. We design for resistance against these natural impacts again and again, while heavily relying on insurance policies and large sport arenas for reassurance, comfort and financial aid. For example, Katrina in 2005 relocated millions of people to different states all over the country, decreasing New Orleans overall population by more than 50%. This concept of an exodus of people after every disastrous hit we endure can not be our only solace or solution towards natural disruption. A solution would need to be developed that can preserve the natural infrastructure while solving the issue of displacement that occurs during these events.

Through analyzing varying theories regarding climate change and storm surge, what parameters can be set in order to provide a resilient solution towards this inevitable problem?

- A solution that doesn’t resist the change in environment, but rather accepts and adjusts towards it
- Everyone, regardless of class or income, shall have full access towards this solution
- This solution promotes interaction amongst one another so no one can feel isolated in this time of hardship
- A strong emphasis on nature with it’s regenerative and sustaining characteristics, should be applied towards this final solution
- This solution should equally give sense of ownership towards all user groups, allowing them to have a sensual connection rather than just physical
The first of the criteria that would be needed is the ability to adjust accordingly towards inevitable disruption in environment, landscape and community. Resistance towards inevitable change causes chaos and destruction and in some cases, more repair time and cost. Figures 7, 8 and 9 below show some of the many examples that can come out of trying to resist natural disruption.

Evidently, resistance is not the only solution, nor is it 100% foolproof, and instead, we should be deciding “whether we should build faster and harder to keep it out, or find a way to gently merge ourselves with the water once again” (Oppenheimer 17).

The title word that is concluded from this summary is: **Adaptability**

**Features:**
- Acceptance of natural elements such as water, wind and sunlight
- Not only allowing change but thriving and benefiting from it
Along with being adaptable, a resilient solution is rendered useless if only a handful of users can successfully use it. Recent projects that contribute towards solving housing displacement due to storm surges and flooding do currently exist, however, both investment and maintenance for a resilient home are far higher than traditional homes. Ultimately, the challenge of designing for resiliency is not just for the performance aspect of the structure, but the ability for anyone to benefit from it, regardless of income. Below are Figures 10 and 11 that show examples of resilient housing solutions, but primed for a specific wealthier user group.

The title word that is concluded from this summary is: **Affordability**

**Features:**
- Size of dwelling is at a minimum
- Use of local materials and simple construction methods

---

**Figure 10: **“Dome of a Home” Available for Rent: $5000/wk**

**Figure 11: **Amsterdam House Boats Available for Purchase: $460,000 and $780,000**
With effective resilient design, you can possess the adaptability towards incoming change, and the ability to afford it, but socially, what is gained? Social interaction amongst one another within a time of hardship is defined by reaching out to those around you. Giving and receiving support is important. A resilient design that incorporates social rehabilitation is an important asset that most responsive organizations don’t offer, but rather just suggest for the individual. Figures 12 and 13 below show examples of community appearing as part of the emotional healing process.

The title word that is concluded from this summary is: **Community**

**Features:**
- Sense of Place for the individual
- Promoting interconnectivity amongst people

![Figure 12: Community organizations rebuilding during Illinois tornado](image1)

![Figure 13: Group involvement of rebuilding house after tornado](image2)
The ability to prepare for the future through promoting natural strategies and elements within design are a key criteria of effective resiliency. Adaptability is a part of resiliency by it’s preparedness for incoming change or disruption, but how it physically undergoes that is where natural features come into effect. With resiliency design, especially on coastal regions, nature has to be apart of the process, whether it’s through preservation or enhancement. Nature is an element that thrives with us as a species, however, nature's ability to adapt overtime towards disruption is an important attribute that we as a species can learn from. In order to have an effective resiliency design, nature must become incorporated into the vocabulary of architecture, between topography and bathymetry, land and sea.16 Figures 14 and 15 below show how nature is emphasized through design to promote a self sustaining ability.

The title word that is concluded from this summary is: **Ecology**

**Features:**
- Strong ecological contribution towards the design
- An equity of health between both nature and humans
Lastly, an effective element of resiliency is a sense of ownership for the individual. During a traumatic event, the individual seems lost, or misplaced within the environment. A solution that has a strong community aspect can be helpful for the individual, but when they are not engaging in social activities, where do they reside? What could make an individual feel better, a tent or a tent that is his/her favorite color? Current relief efforts are effective, but lack the small attribute of being adjustable for a certain user group. Figures 16 and 17 below show current methods of recovery and streamline design of being similar. What would be most effective in resilient design methods or how the community has a sense of ownership, what they build belongs to them.\(^\text{17}\)

The title word that is concluded from this summary is: **Customization**

**Features:**
- Personal attributes can be added or taken away at the choice of the user
- Use of details that fit the user group’s preference

---

**Figure 16:** Relief tents in Haiti after Hurricane

**Figure 17:** Use of gymnasium for relief after Sandy
### Underlying Principles of the Design Hypothesis to the Proposed Project: Specified elements of effective resiliency

After taking the synthesis of the 5 needs for effective coastline resiliency, each element is subdivided into 7 subcategories, in reference to the sources listed below each category. For graphical reference, the chart on the page to the right has each category listed divided into a pie chart graph theme for visual clarity.

<table>
<thead>
<tr>
<th>Adaptability</th>
<th>Affordability</th>
<th>Community</th>
<th>Ecology</th>
<th>Customization</th>
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</thead>
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<td>- Independence from Infrastructure</td>
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<td>- Passive Systems</td>
<td>- Operable Enclosure</td>
</tr>
<tr>
<td>- Natural Activation</td>
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<td>- Diverse and Redundant Systems</td>
<td>- Minimum Floor Area/Surface Area</td>
<td>- Programming Initiatives</td>
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<td>- Find and Promote Adaptation in Nature</td>
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</tr>
<tr>
<td>- Envelope and Tech Sophistication</td>
<td>- Materiality Usage</td>
<td>- Layered Program</td>
<td>- Ecological Contribution</td>
<td>- Static Function</td>
</tr>
<tr>
<td>- Counteractions and Response</td>
<td>- Accessible Transit</td>
<td>- Shared Work Areas</td>
<td>- Wildlife Supplement</td>
<td>- Mobile Function</td>
</tr>
</tbody>
</table>

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**Adaptation to Climate Change: A Spatial Challenge**  
By Rob Roggema

**Companion: Introduction to housing**

**Urban Land Institute:**  
*Ten Principles for developing affordable housing*

**Inhabitant: WeWork and WeLive**

**Internation Living Future Insitute:**  
*Living Building Challenge 3.0*

**P2P Foundation:**  
*Open Design and Mass Customization in Architecture: Open Source Building Alliance from MIT*

**DesignIntelligence:**  
*The Design Implications of Mass Customization*
Resiliency Pie Chart

CUSTOMIZATION FACTORS

OPENABLE ENCLOSURE
Energy consumption of the facade, wall, and ceiling can be significantly reduced through the use of movable, window, and door systems.

PERMEABILITY
Openings that allow for cross ventilation can improve energy efficiency and indoor air quality.

ADDITIVE ABILITY
Modular systems that can be easily adjusted and reconfigured to meet changing demand.

PREDICTABILITY
Designs that are easily adapted to changing conditions and technologies.

SELECTIVE DETAIL
Details that can be easily modified to accommodate future changes. Materials, finishes, and components should be selected to allow for flexibility.

STATE FUNCTION
Components that serve multiple functions, such as providing energy generation or storage.

MOBILE FUNCTION
Systems that can be easily moved or repositioned to meet changing needs.

RIGIDITY
Structures that can withstand significant changes without compromising safety or performance.

ECONOMICS
Cost-effective solutions that can be easily implemented and scaled.

RESOURCES
Sustainable materials and methods that can be easily sourced and integrated.


Author Figure 1: Graphical Pie Chart

ADAPTABLE FACTORS

TRANSFORMATIVE INFRASTRUCTURE
Systems and facilities that can be easily adapted to changing needs and technologies.

NATURAL ACTIVATION
Designs that incorporate natural elements, such as water features, green spaces, and light, to enhance the user experience.

DIVERSE AND RESILIENT SYSTEMS
Systems that can thrive under a variety of conditions and can adapt to changing needs.

FIRE AND SMOKE PROTECTION
Designs that incorporate fire and smoke protection systems, such as fire-resistant materials and smoke detectors.

ENVIRONMENTAL AND TECHNOLOGICAL AUTONOMY
Designs that incorporate systems and technologies that can be easily managed and maintained.

CONVERSATIONAL STREAMING
Systems that can be easily integrated with other systems and technologies.

REPLENISHMENT
Designs that incorporate systems for energy generation, such as solar panels or wind turbines.

AFFORDABILITY FACTORS

INDEPENDENT INFRASTRUCTURE
Systems and facilities that can be easily adapted to changing needs and technologies.

SPATIAL PROGRAM
Designs that incorporate systems and technologies that can be easily adapted to changing needs.

MINIMUM FLOOR AREA/SURFACE AREA
Systems and facilities that can be easily adapted to changing needs and technologies.

GREENER ENVIRONMENTS
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

STANDARDIZED DESIGN
Systems and facilities that can be easily adapted to changing needs and technologies.

MATERIALS & OBJECTS
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

ACCESSIBLE TRANSPORT
Systems and facilities that can be easily adapted to changing needs and technologies.

COMMUNITAL FACTORS

ACCESSIBLE FOR COMMUNITY
Systems and facilities that can be easily adapted to changing needs and technologies.

PUBLIC SAFETY
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

PROGRAMMATIC INITIATIVES
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

DEFINITION
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

LAYERED PROGRAMS
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

SHARED AREAS
Designs that incorporate systems and technologies that can be easily adapted to changing needs and technologies.

References

RESOURCES

Author Figure 1: Graphical Pie Chart

References

RESOURCES

Author Figure 1: Graphical Pie Chart

References

RESOURCES

Author Figure 1: Graphical Pie Chart

References

RESOURCES

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References

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RESOURCES

Author Figure 1: Graphical Pie Chart

References

RESOURCES
As mentioned before, multiple projects have been contributed towards the issue of disastrous flooding, both from storm surge and inevitable climate change. This next section is consisted of analyzing 4 projects that contribute towards resiliency in regards to the graphical chart containing the 5 elements of effective resiliency.

Each project is a different typology of response and design, and through this intensive analysis, the synthesis will begin to reveal patterns or trends that occur between the projects.
Typologies of Case Studies

Galveston, TX
**Pros**
Utilizing the person giving them access to inhabit the natural recreational areas
Ecological sustainability applied throughout
Embracing the water through aesthetic canals and rivers that are overlooked by the housing structures

**Cons**
Still left with residual space after different areas are flooded, meaning no way to embrace water once it takes over everything but the buildings
Strong landscape/urban solution, but individual building structure is questionable against wind/water loads from hurricane

**Characteristics:**
**Scale:** LARGE
**Disaster Timeline:** PRE / POST
**Primary Focus:** CLIMATE CHANGE
**Status:** UNBUILT STUDENT PROJECT
**Relevance:** HOUSING, WATER MANAGEMENT

Urban Corrugations
Zihan Chen, Elizabeth Mickey
2009

Galveston Island, Texas
Author Figure 3: Galveston Section Diagram

Adaptability

Affordability
**Community**

- **Centralized Shared Space w/Balconies That Promotes Interconnectivity Amongst Users**
- **Multi-Use Market Space**
- **Existing Ecosystem**

**Programming Initiatives**
Designed initiatives that are allocated to promoting interaction amongst other user groups within the context.

**Transparency and Openings**
Spaces or moments that are created through the design to allow use to visually, acoustically or physically connect with other users.

**Layered Program**
Areas or spaces that have multiple uses/purposes for different programs. This can make typical privatized space into live public space.

**Accessible for Community**
Design that possesses qualities that are most essential and unique to only the community.

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**Ecology**

- **Site Terra-Forming (Corrugation) to Control Flow in Rise in Water Levels**
- **Cross-Ventilation Wind-Flow to Passively Cool the Space**
- **Tall Grass and Ponds That Provide Wildlife Habitat**
- **Artificial Canals w/ Plantings**
- **Natural Barrier Provided by Plantings and Small Vegetation**

**Ground Articulation**
Built structure and site construction, to a limit, doesn’t harm the pre-existing site condition.

**Passive Systems**
Utilizing Earth’s natural resources such as wind, water, sun, ground as a means of producing energy.

**Wildlife Supplement**
Local wildlife activity is not disrupted and is incorporated into design priority.

**Native Landscaping**
Natural elements/characteristics that are local in order to allow for max regeneration after becoming reduced.

**Equity of Health**
The health conditions for both humans and vegetation are equally emphasized and thriving off one another.

**Ecological Contribution**
The activity of both existing ecology and design mutually thriving. Additionally, the design is enhancing the ecological infrastructure.
**Customization**

**Static Function**
The design is a static element which is custom to fit one specific site.

**Pre-Fabricated Design**
Design that is custom fit to align with pre-existing elements or another form of tectonic construction.
MOMA, New York
On The Water MOMA Exhibit (Literary):
Projects for NY’s and NJ’s Waterfront / 2010

Pros

Natural activation through vegetal elements, promoting resistance with nature.

Terra-formed landscape embraces to climate change by providing pre-formed landscape that diverts water flows away from mainland.

Adaptive reuse of existing coastal conditions to enhance coastline space to provide both environmental and social amenities.

Cons

Seen as landscape solution to protect existing inhabitants within the mainland, however, no provisions of housing for the possibility of displacement on the coastline.

Affordability of landscape solutions are very low, considering the scale of the projects and the sophisticated strategies/systems used.

Characteristics:

Scale: LARGE

Disaster Timeline: PRE / POST

Primary Focus: CLIMATE CHANGE

Status: ARTICLE FOR UNBUILT COMPETITION PROJECTS

Relevance: WATER MANAGEMENT

Hudson River, NJ and NY
Author Figure 5: MOMA Graphical Pie Chart

Customization Factors
- Customizable Design
- Adaptability
- Ecology
- Affordable
- Communal

Adaptability Factors
- Transformable Infrastructure
- Natural Nurturing
- Disease and Resilient Ecology
- Time and Persistent Adaptation
- Anticipatory Change

Ecology Factors
- Passive Systems
- Open Air/Animation
- Recycling/Reuse
- Native Landscapes
- Ecolocal Contribution

Affordability Factors
- Independence from Infrastructure
- Usable/Available Infrastructures
- Maximum Floor Area/Space Use
- Geographical Variation
- Streamline Design

Accessible Factors
- Public Safety
- Programming Initiatives
- Community Engagement
- Environmental

References
- Nordenson, Andrew. "MOMA Exhibit: On the Water / 2010"
Adaptability

Author Figure 6: MOMA Section Diagram

Affordability

RESILIENCE TRANSENDS SCALES.
Strategies to address resilience apply at scales of individual buildings, communities, and larger regional and ecosystem scales; they also apply at different time scales—from immediate to long-term.

DIVERSE AND REDUNDANT SYSTEMS ARE INHERENTLY MORE RESILIENT.
More diverse communities, ecosystems, economies, and social systems are better able to respond to interruptions or change, making them inherently more resilient.

RESILIENCE ANTICIPATES INTERRUPTIONS AND A DYNAMIC FUTURE.
Adaptation to a changing climate with higher temperatures, more intense storms, sea level rise, flooding, drought, and wildfire is a growing necessity.

FIND AND PROMOTE RESILIENCE IN NATURE.
Natural systems have evolved to achieve resilience; we can enhance resilience by relying on and applying lessons from nature. Strategies that protect the natural environment enhance resilience for all living systems.

SOCIAL EQUITY AND COMMUNITY CONTRIBUTE TO RESILIENCE.
Strong, culturally diverse communities in which people know, respect, and care for each other will fare better during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

MATERIALITY USAGE
Use of local vernacular materials reduce construction costs, which in parallel, reduces living costs.

THROUGHOUT THE PROPOSALS, THE BENEFITS OF A MORE VARIED SEAFLOOR ARE ESPoused, IN ARTIFICIAL AND NATURAL REEFS AND ISLANDS. USE OF MATERIALS Ranging FROM REcycled GLASS TO SYSTEMS AND CONVEnIential LANDFILL.

- BARRY BERGDOLL
Author / Rising Currents / 2007
"...AND SUPPORT RECREATIONAL FACILITIES AND RESTORED NATURAL HABITATS, AND THEY PROPOSE FLEXIBLE FORMS OF INTERPENETRATION OF WATER AND LAND, EXTENDING THE SEA INTO THE SED AND THE SED INTO THE CITY."

**Community**

Author Figure 7: MOMA Section Diagram 2

**Ecology**

Author Figure 8: MOMA Section Diagram 3
Customization

Author Figure 9: MOMA Section Diagram

"...TYPICAL OF ALL THE RISING CURRENTS PROJECTS IN BEING SITE SPECIFIC WHILE CONTAINING MANY IDEAS WITH FAR WIDER APPLICABILITY."

- BARRY BERGDOLL
  Author / Rising Currents / 2007
Biloxi Model Home Program, MS
ARCHITECTURE FOR HUMANITY:
Biloxi Model Home Program / 2007

Pros
- Inexpensive solution for housing which allows the user to still be connected to their sense of place
- Customization of each home can vary, depending on the user’s preferences
- Use of natural/recycled materials for construction

Cons
- The raised floor condition creates a lack of connection with the ground, therefore resisting the water rather than adapting
- Ground floor will still be in need of repairs in the aftermath of a storm surge

Characteristics:
- Scale: SMALL
- Disaster timeline: PRE / POST
- Primary focus: CLIMATE CHANGE/STORM SURGE
- Status: BUILT PROJECTS
- Relevance: SMALL SCALE CONSTRUCTION WITH VERNACULAR MATERIALS

Biloxi, MS
Adaptability

Author Figure 11: Biloxi Section Diagram

Affordability

Author Figure 12: Biloxi Section Diagram 2
Community

Author Figure 13: Biloxi Section Diagram 3

Ecology

Author Figure 14: Biloxi Section Diagram 4
Customization

Author Figure 15: Biloxi Section Diagram

Emotional Attribution
Personal characteristics that connect one to its communal comfort of their home.

Additive Ability
User can selectively construct/reconstruct desired elements that physically connect to the design.

Selective Details
Pre-installed with user's choice of material finishes, color palettes, and other finite details within the design.

Static Function
The design is a static element which is custom to fit one specific site.
Paper Church, Japan
THE HUMANITARIAN WORKS OF SHIGERU BAN:
PAPER CHURCH / 1995 - 2005

**Pros**
- Innovative solution for relief structure, and architectural distinction is still strong despite the minimal amount of materials.
- This method of building ranges from all typology scales, rather than just housing.

**Cons**
- Project is effective for only post disaster.
- Temporary solution that will need to be re-established in the next aftermath of another storm surge.

**Characteristics:**
- **Scale:** Medium
- **Disaster Timeline:** Pre / Post
- **Primary Focus:** Storm Surge
- **Status:** Temporary built projects
- **Relevance:** High affordability and innovative material usage

Kobe, Japan
The Humanitarian Works of Shigeru Ban: Paper Church / 1995 - 2005

Author Figure 16: Paper Church Graphical Pie Chart
Adaptability

Social interaction are promoted through structures.

Social equity and community contribute to resilience.
Strong, culturally diverse communities in which people know, respect, and care for each other will fare better during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

Diverse and redundant systems are inherently more resilient.
More diverse communities, ecosystems, economies, and social systems are better able to respond to interruptions or change, making them inherently more resilient.

Resilience transcends scales.
Strategies to address resilience apply at scales of individual buildings, communities, and larger regional and ecosystem scales; they also apply at different time scales—from immediate to long-term.

Affordability

Promote leadership
Taking a stance on leading a community through the effort to develop affordable housing.

Project-based vs. tenant-based
Now regarded as a false choice. Primary focus is provisions for everyone, rather than just the privileged.

Household size
Size of dwelling should be at a minimum, in order to reduce labor costs and SF estimates.

Work opportunities
In order to have the ability to make payments, the design should incorporate part-time opportunities for all users.

Materiality usage
Use of local vernacular materials reduce construction costs, which in parallel, reduces living costs.

Author Figure 17: Paper Church Section Diagram

Author Figure 18: Paper Church Section Diagram
Community

Author Figure 19: Paper Church Section Diagram

Ecology

Author Figure 20: Paper Church Detail Diagram
Customization

**Author Figure 21: Paper Church Plan/Detail Diagram**
After analyzing the 4 case studies, a common trend began to develop based on the characteristics that each project had and what it attributed towards.

The Galveston and MOMA Projects happened to be at a larger scale than the other two, and through the analysis, these projects seemed to contribute heavily towards the adaptability and sustainability category. This was because of these projects repetitive priority towards ecological preservation and natural activation of the landscape. The remaining 3 categories of Affordability, Community and Customization we’re not absent in these projects, but overall, these projects had more strategies and techniques developed towards ecological advancement, rather than housing amenities.

With the remaining 2 projects, Biloxi Model Home Program and Paper Church, these projects were at a sizable smaller scale compared to the previous 2. The common trend with these two was the contribution towards Community, Affordability and Customization. This seemed to be because of each project’s scale and program development. The model home program was rehabilitating a house within the hurricane prone area, using local materials and cheap construction which made it sustainable to an extent. However, the main priority of the Biloxi model home was focused more on the housing amenities of the individual. Same with the Paper Church in Japan, it’s main use and purpose was to revitalize the local community through a common place of worship, and constructed at a smaller scale for people, therefore considering the individual.

All 4 projects however did have a contribution towards all of the 5 criteria of effective resiliency, but the main objective of each project had a slightly different purpose, determining each project diverse. As effective as these projects are, they seemed to be linked to one common element, the overall scale of the design.
With both Galveston and MOMA, these projects focus primarily on the ecological enhancement of the landscape, because of its large scale approach.
With Biloxi and Paper Church, the main focus of the projects here began to target the individual, due to its small scale approach.
Flow Control Mechanisms / Terra-Forming

Soft Edges/Boundaries

Swales and Berms: Ground Articulation

Concept model of Large-Scale Approach:

Use of Nature for Acceptance of Water

Ecological Sustenance / Native Landscaping

Transformable Infrastructure

Flow Control Mechanisms

Author Figure 23/24: Conceptual Large Scale Model
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<thead>
<tr>
<th>PRIORIZED CRITERIA</th>
<th>SPECIFIC FEATURES</th>
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<th>CRITERIA CHART</th>
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<td><strong>Customization</strong> +4</td>
<td>User Personalization, Universal Elements (Kit), Mobile Function, Pre-Fab Elements</td>
<td><strong>People/Use Enhancement</strong></td>
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<td>Equitable Program, Minimum Surface/Floor Area, Materiality Usage</td>
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<td><strong>Community</strong> +6</td>
<td>Accessible, Visibility, Community Engaged, Programmed - Layered</td>
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<tr>
<td><strong>Affordability</strong> +4</td>
<td>Equitable Program, Efficient Construction, Streamline Design, Native Material Usage</td>
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<td></td>
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<tr>
<td><strong>Community</strong> +5</td>
<td>Contextual Placement, Visible, Community Engaged, Programmed - Layered</td>
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</tbody>
</table>
Concept model of Small-Scale approach:
Use of nature for avoidance of water

Community Engaged
New constructed dwelling is placed within the pre-existing context

Minimum Surface/Floor Area
Room sizes and program are minimal for most affordability

Native Material Usage
Local construction materials are used for assembly and structure for more affordability

Raised Floor Condition
Entry floor is raised for the avoidance of water and preference by owner

Efficient Construction
Methods of construction are low cost and maintenance

Contextual Placement
Contextual characteristics such as similar floor area and building height

Author Figure 24/25: Conceptual Small Scale Model
2.0 Site Introduction: Where will this solution be implemented?
Unfortunately, natural storm surges and global sea level rise is not just an isolated issue; this is an issue that is faced all over the world. When investigating a site and its existing parameters, one of the main factors that must be considered is the program.

Based on the previous analysis of case studies, the program would need to be consisted of a community based infrastructure, one that is obviously near the coastline. And also, one that is in the wake of inevitable destruction caused by storm surge or global sea level rise.

Locally, the US is a magnet for hurricanes, and global sea level rise would end up affecting more than 50% of the population, given that they live within a reasonable distance towards the waterline. One of these highly affected areas suffered the same magnitude of destruction but got little acknowledgment during this period of disruption. This city is named **Biloxi, Mississippi**.

**Biloxi, Mississippi**

Current Population: **45,637**

Elevation (Above Sea Level): **19.7’**

Renowned as: **Casinos and Gaming**  
**Sport and Casual Fishing**
Author Figure 27: Site Location
2.1 Relevance of Site to Hypothesis: Why this location?

1 - Hurricane Prone Area (Recorded Hurricane paths within the past 50 years)

Past hurricane characteristics and effects

Hurricane Katrina was by far the most destructive hurricane to affect Biloxi. At a total surge height of 25' in some areas, Katrina was able to remove certain buildings from their foundations, and lift them farther inland, specifically the Miss Grand Casino, as shown above.

Inundation map done by Katrina. This map also doubles as the new expanded flood zone for FEMA. Any newly constructed dwelling within this zone will need to be constructed with a F.E. of 17' above sea level, in order to meet FEMA Code.
Separation between tourist and residents - through scalar exclusion and no intermedial community spaces that are shared by all user groups.
3 - Global Sea Level Rise Risk (Data taken from Surging Seas)

Going from South to North, Biloxi’s terrain goes from higher to lower. When a change in sea level occurs, the north end of the peninsula is affected first. Specifically, the existing wetland / empty field within the cove on the North end, which acts as a canal for channeling water inland.
Interview with David Perkes

David Perkes

Founding director of Community Design Studio, a nonprofit organization established shortly after Hurricane Katrina. David and his team of designers and engineers are responsible for the construction of over 260 new houses along the coastline. Their office is based out of Biloxi, MS, while being an extension to Mississippi State University's Architecture Department.

Most newly constructed houses in Biloxi didn't adopt the FEMA Floodmap ordinance height for residential dwellings, which most of these base elevation heights are at 17' high
- this leads to for most houses having an extra storage space underneath the house, and different house owners applied different ways to disguise the pier structure underneath the house

Community Design Studio has done more than 250 new houses after Hurricane Katrina, most houses were on lots that were within the floodzone, and each one has been elevated some amount

Houses are not consistent heights everywhere due to some owners wanting to raise the house higher than the base set elevation for the given street, so the underneath space can be utilized or they can get cheaper flood insurance - free board

FEMA to local building code requires that all newly residential construction has to be above the base foot elevation, commercial has to be floodproof

Belongings are more important than the house - harder to replace family photos and memorable objects

Question is what to do with existing houses that remain after floodzone codes change...
- before Katrina: 11' height
- after Katrina: 17' height
- floodzone coverage area increased, adding more homes within the zone
- some houses had to be gutted and redone, money became big issue
- technically, a house does not have to be built to the FEMA flood elevation height, unless the owners begin work on the house that exceeds half of the houses value. If this happens, the house/building must be brought up to code = raising the house up
2.2 Examining Existing Site Conditions: How the current context of the site reflects the 5 elements.

Adaptability

Currently, Biloxi, as a coastal land mass, possesses different natural methods for adaptability towards a changing environment. However, one method was carried out artificially by a local office, Gulf Coast Community Design Studio led by David Perkes. This method recreated a bayou with a natural landform that controlled water flow and collection during tidal, and even minor storm surges.

Natural landforms are able to control water more efficiently due to water being organic in nature, the form that controls it should mimic a dynamic, fluid form.

Wetlands act as natural buffers to wave force and recharges the water into the ground over a period of time.

Keegan Bayou

Architect: Gulf Coast Community Design Studio (Biloxi)

Purpose: Retention and release of water if baseline increases, deterring it away from the inland communities.

Author Figure 33/34: Existing Wetland Map, Performative Wetland Characteristics
Existing methods for floodproof housing

**Method 1: Floating Dwelling**

**ADAPTING**

**Pros:**
- Bucancy allows for natural adaptation
- Initial installation reduces the water excess opportunity for inland displacements and costly strategies

**Cons:**
- Catastrophic and unpredictable gravity damage might not occur
- Introducing new foundation technologies might raise the pumping ratio

**Method 2: Raised Dwelling**

**AVOIDING**

**Pros:**
- Dwelling can remain stationary unlike existing context
- Bucancy cheaper than new constructed dwelling

**Cons:**
- Raised foundation diversions can be from ground
- Raised dwelling not a first step to protection through no height

---

Existing housing typologies for Biloxi

**Surf Height Range:**
- 0'
- 2'
- 2.5'
- 3'
- 4'

**Exposed or Encased Sulfate:**
- Exposed
- Encased
- Exposed
- None

**Dwelling Intensity Efficiency:**
- Great
- Good
- Poor
- None

**PTMA Upheld Status:**
- No
- No
- No
- No

---

Author Figure 35/36: Floodproof Housing, Existing Housing Typologies
Affordability

Part of the challenge for designing for effective resiliency is incorporating affordable and inexpensive solutions, in order to provide an equity of usage from all user groups, regardless of income. The Census data below shows the different census blocks and their varying median income as well as current demographics.

Median Household Income

By City-Data.com _ Harrison County, Biloxi, MS

Author Figure 37: Median Household Income
Individual Census Blocks

By City-Data.com _ Harrison County, Biloxi, MS

Author Figure 38 (Sourced from City-Data.com): Census Blocks
Community

The current land use of the site is predominantly tourism focused, with high end casinos and resorts that are targeted towards outside visitors. Due to the atmosphere gambling and gaming can bring, the residents of the community prefer not to be strongly associated with casinos.

Currently in Biloxi, there is a strong lacking of true, communal gathering spaces or areas that enrich the public atmosphere. The current residents do wish for more public amenities or public gathering spaces, predominantly focused through a vegetal and natural lens.

Survey of desired park/communal spaces from local residents
Survey conducted by GCCOS for Planning in East Biloxi, MS.

Main Tourist Programs

Author Figure 39/40: Main Tourist Programs, Main Resident Desired Programs
Ecology

Much alike the existing coastline areas along the Gulf (Galveston, Gulfshores, Bay St. Louis), the predominant natural landscape are made up of wetlands and marshes. When looking at Biloxi, approximately, only 20% of the coastline edge are natural wetlands. Wetlands provide a variety of beneficial and natural strategies to preserve the ecological infrastructure along with buffering disastrous floods from storms and sea level rise.

Existing Wetlands

Korgan Bayou
Big Island
Channel Island
Bayou Augustine
Clay Point Bayou
Deer Island

Existing Wetland Typologies

- Eutuine Wetland
  - Estuaries tidal habitats: estuarine tidal wetlands that are usually surrounded by land or firm piers, often situated on or along the shoreline.
  - Filters water and improves overall quality and absorbs nutrients.

- Scrub/Shrub Wetland
  - Scrub/shrub vegetation is found in areas with salt marshes.
  - Filters water and improves overall quality and absorbs nutrients.

- Palustrine Emergent Wetland
  - All-vegetated wetlands dominated by herbs, shrubs, or woody plants, typically situated on or along the shoreline.
  - Well-endowed habitat for small invertebrates, reptiles and shellfish.

Benefits

- Density of subtidal flora serves as fish nursery ground
- Tall grasses enhance buffer from wave force from storms
- Prime bird feeding ground
- High amount of roots stabilizes soil conditions
- Filters water and improves overall quality and absorbs nutrients

- Diversity of plant typologies promote biodiversity
- Tall grasses enhance buffer from wave force from storms and provide vital food and habitat
- Heavier vegetation provides more effective buffer from storm winds
- Can occasionally provide natural barrier to protect wetland and species
- Filters water and improves overall quality and absorbs nutrients

- Prime feeding ground for migratory birds
- Moss and Lichen provide nutrients and food for microorganisms

Author Figure 41: Existing Wetland Typologies
Author Figure 42: Existing Wetland Characteristics
Customization

The main user group that involves customization would be the residents, considering they are the ones that own their homes, and have the freedom to express his/her own characteristic preferences. Below are some examples of how the users claim a sense of ownership towards their dwellings.

Author Figure 43: Existing Customization Features
3.0 Specific Site for Intervention: Where specifically on the site will this proposal be implemented.
Through the lense of the five key criteria for effective resiliency, the site of East Biloxi was looked at for potential enhancement of each category. The specific area of study is the north bay along the water.
3.1 Current Condition: What is the current water flooding pattern?
3.2 Landscape Articulation: Terra forming the coastline to perform *Adaptability*, *Ecology* and *Community* to reduce the flooding effect shown above.

**Existing Coastline**

**Push Coastline Edge**
An increase in shoreline edge and “sawtooth” form slows and controls water flow more efficiently

*Adaptability*

**Added Diagonal Grids**
Un-ordered grid layout to promote organic movement from water

*Adaptability*
**Added Horizontal Grids**
East-West grid layout to continue existing language of neighborhood streets

**Shifting/Cutting Land Mass along grids**
Sporadically breaking up land mass through cut/fill methods and infilling to promote natural water flow

**Implementing Vegetal Borders**
Lining edges with wetlands and marshlands that improve the ecological infrastructure and performance of the landscape

**Community**
**Adaptability**
**Ecology**
3.3 Contextual Relationship: How does this articulation relate back to the existing context?

Roadway Circulation

Redeveloping the existing dirt path into a redefined access road horizontally through the site to bring more walkability and access.

Continuing the physical connection between the existing neighborhood roads into the site, in order to continue the programmatic axis of the residential units.

Redeveloped Road

Extending Streets from existing neighborhood

Author Figure 47: Roadway Proposal
While looking at the site of Biloxi, there are moments that resemble community interaction. These moments are specified by their building types, and their current program. This intent is to implement similar zones or atmospheres that reflect the existing community context, within the new proposal.
Proposed Site Program and Structures

Proposed Structures:
- Eco-Casino
- Community/Learning Center
- Market Stands
- Aquaculture/Indoor Farming Towers
- Affordable Single Family Resilient Housing

Preserve
- Nature Trails
- Nature Parks
- Existing Wetlands

Recreation
- Recreational Fields
- Exercise Parks
- Dog Parks

Activated
- Community Center
- Tidal Activated Areas
- Hydro-integrated Platforms
- Farming Zones

Communal
- Market Stands/Grocery
- Industrial Habitats
- Educational Areas
- Community Gardens

Dwelling
- Eco-Casino
- Housing

Author Figure 49: Programmatic Plan
4.0 Landscape Typologies: Zooming in on the spaces created from the site articulation form, and creating scalable design moments. (Canals, Ponds, Mounds, etc...)
Boardwalk over the canal made with **recycled wood from abandoned piers** along the northern coast of Biloxi. Incorporated **customizable bench that folds into a table for different uses** along boardwalk path. Dock condition placed at 6'-7' elevation to anticipate sea level rise / storm surge. Boardwalk connects existing community context into proposed tourism context in order to unify the two user groups. Coastal plantings along ridge-line to **enhance the existing ecological infrastructure**, while providing adaptation via plant absorption and groundwater recharge.
Platforms made from recycled wood from abandoned piers or abandoned houses. Different platforms and walkways are placed at different heights to anticipate different levels of water rise. Coastal plantings are implemented in order to have artificial and natural elements shared together. Advertisement stands are added throughout in order to give any user the ability to project or sell goods or services to the public. Platforms are open to the public and connect physically or through interconnectivity with one another.
Proposed housing condition matches the current building means and methods of Biloxi by being raised and made from vernacular material. The elevated condition of the house allows for an expectation of different levels of water rise. The use of passive systems and natural landscaping enhances the ecological infrastructure. The user has full personalization towards the house, regarding the color, material, landscaping and the operable panels placed below. The panels below the 17’ FEMA Code give a stronger purpose to the empty unconditioned space and raise opportunity for the user to take advantage of the space.
The active green space doubles as a flood-able park during the time of a storm event. The park is open and free towards everyone, and enriches the concept of equity. Active green space is one desire from the existing community of Biloxi. Heavy vegetation and thriving plant life invites local wildlife to endure. Built in play park which includes playgrounds and workout spaces for children and young teens to enjoy and feel a sense of belonging to.
Retention condition allows for water flooding and depots it away via groundwater recharge. The river element allows for secondary transit including small boating and kayaking. River condition connects back towards community center and casino land pier. Heavy natural vegetation enhances ecological infrastructure and adheres to wildlife. Art kiosk stands placed throughout to allow user to express themselves.
Nature walks and trails provide raised boardwalk conditions as well as heavy vegetation in preparation of storm / sea level rise flooding. The boardwalks are made from recycled material and are open for everyone. Through global sea level rise, the conditions of the boardwalk allow for different program iterations such as fishing or boating. The heavy vegetation acts as a wildlife enhancement and contribution. Along the trails are informational kiosks and historical markers that relive the history of Biloxi and the importance of coastal vegetation.
The wind farm collects and harnesses energy from everyday winds to storm winds at 70 mph, and responds by providing energy for the site. The wind farm allows for the independence of mainland infrastructure. The existing community can visit and learn about wind power and energy through educational kiosks. The wind farm uses natural energy from wind loads, and does minimal impact to the surface. The wind farm can be manually shut off or adjusted for hurricane winds in the event of a storm event.

Author Figure 57: Alternative Power Collection
5.0 Scalar Resiliency Proposal: Overlaying the design characteristics of both Large Scale solutions and Small Scale solutions within one final outcome.
5.1 Large Scale Resiliency: Master Site Plan
**2’ Sea Level Rise**

**Vegetate Borders** begin to absorb and transfer more tidal water via groundwater recharge.

Wetland Type: **Estuarine Wetland** - High amount of deep root stability to prevent erosion.

*Author Figure 59: 2’ Sea Level Rise*
Flood-able Zones are inundated and function as water storage basins.

Landscape Strategy: Flood-able Park
Land mass basin as a purposeful collector for large bodies of water.

Author Figure 60: 4' Sea Level Rise
6’ Sea Level Rise

Landscape Strategy: *Multi-Use Levee and Temp. Flood-wall* - Increase in filled land and barrier wall to prevent further travel of water inland

**Land Piers/Mounds** and **Temporary Flood-wall** prevent water from reaching farther inland or near inhabitable zones.
17’+ Storm Event

**Land Piers/Mounds, Raised Structures and Temporary Flood-wall** preserve and prioritize any means of travel towards **Casino/Relief Center** from water inundation.

Landscape Strategy: **Multi-Use Levee, Temp. Flood-wall and Raised Structures** - Water prevention methods in order to prioritize transport via roadways/waterways towards Relief Center.

Author Figure 62: Storm Surge 17+
5.2.1 Intermediate Scale Resiliency: Casino Land Pier
Author Figure 68: Casino Section 3
Current Condition: 0'-2'

Author Figure 69: Current Condition Casino
Sea Level Rise: 6’ + (50yr Span)

Author Figure 70: Sea Level Rise Casino
Storm Event: 17' +

Author Figure 71: Storm Surge Casino
Casino Resort / Disaster Relief Center: How the structure withstands during time of disruption (storm event).

1. "Power-Flower" Wind Turbines (Electricity Generator)
2. Sloped Roof (Water Collector)
3. Vertical Chase (Conduit and Piping)
4. Intensive Green Roof (Water Collector)
5. Dome Skylights (Backup Lighting)
6. Concrete Friction Piles (Resilient Structure)
7. "Closed Loop" Geo-Exchange System (Cooling System)
8. Tidal Turbines (Electricity Generator)
9. Water Filtration System (Water Cleansing)
10. Transformer (Electricity Converter)
11. Battery for Wind / Tidal Turbines (Electricity Storage)
12. Grey-water Cistern Storage (Water Collection)
5.2.2 Intermediate Scale Resiliency: Community Center Zone

Community Center Program

Author Figure 73/74: Community Center Plan/Program
Author Figure 77: Community Center Section 2
Current Condition: 0'-2'

Author Figure 78: Community Center Current Condition
Sea Level Rise: 6’ + (50yr Span)

Author Figure 79: Community Center Sea Level Rise
5.3 Small Scale Resiliency: Housing Development

"Everyday" Condition

Storm Event

Author Figure 80/81: Existing/Storm Housing
Temporary Program Iterations

- Mobile Home Office Space
- Wall Mounted Planters
- Wall Drawing Gallery/Storage Space
- Extended Wall for Privacy

Interactive Panels for unconditioned ground floor space become utilized into wind breakers for the FFE at 17”

- Everyday Condition
- Folding panels in a “V” form
- Panels are raised through pulley system
- Panels are fastened and bolted on upper floor
- Storm Event Condition
Reinforcement Bolt
Track Wheel
Steel Track Rail

Metal Pivot
Steel Latching Pin
Timber Panel Frame
3/4" Plywood Sheathing
1/2" Corkboard Panel
2x4 Stud Reinforcement

Pulley System
High Tension Cable
Metal Hook

Section at Pivot/Track Connection

Section at Pulley System

Author Figure 84/85: Detail Sections of Panel System
Current Condition: 0'-2'

Author Figure 86: Housing Current Condition
Sea Level Rise: 6’ + (50yr Span)
Storm Event: 17’+

Author Figure 88: Housing Storm Event
6.0 Reflections and Conclusion: What did I learn from completing this thesis?
The Good: Positive Remarks and Successes

In the beginning, I originally thought that the term “resiliency” was another word for “resistance” or prevention against a disaster of some magnitude. However, after thorough research, analysis and conclusion, I’ve come to realize that its more than just “prevention”. Resiliency is a composition of everything from the architecture to the individual. The architecture can be resilient, but if the individual is not, then it’s not true effective resiliency. While as the individual is resilient, but the architecture is not, then same outcome. Resiliency needs to be addressed at multiple scales, to be truly effective. With this thesis, I’ve approached the project as a solution that incorporates large scale resiliency using large scale characteristics as well as small scale resiliency using small scale characteristics. This way, the project responds towards a community that is highly prone to disastrous flooding both long term and short term.

The Bad: Feedback and Critiques

Although I deem this thesis project to be overall successful, there were moments and elements that unfortunately could not pass through, considering if this project were to be feasibly developed. For one, the housing development was meant to be not only resilient towards disastrous flooding but also affordable. Although the new houses mimicked the similar building construction techniques of the existing housing in Biloxi, they were however not fully developed in terms of affordability, due to it being considered “waterfront” property. Next, the community center structure was lacking a storm surge adaptation, most likely due to it’s elongated form. The form could have been more developed as well as more detailed in regards of how the materiality is designed to withstand high winds and strong wave currents. Lastly, the floodable models did not perform as fully as intended, most likely due to the coarse surface of the acrylic paint and insulation foam, but did give the overall impression on how the landscape responds to water intake.

The Conclusion: What was ultimately learned

Throughout this project, there were successes and failures, but ultimately, the most important aspect is learning from the failures. One element that was understood was the difficult tradeoff regarding affordability and adaptability for housing. It seemed throughout the process of design, one could not be achieved without disregarding the other. Another element that was learned was how water obnoxiously travels in regards to landscape articulation. Although the landscape forms a clean trench or canal for water to travel, it still seems to find ways to seep through different areas that were not intended for it to go. However, as troubling at times this thesis was, I ultimately enjoyed it and learned a good amount about coastal flooding, existing strategies and newly developed strategies that could potentially be incorporated in the near future.
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M.1 Current Condition
M.2 Scalar Resiliency Proposal
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